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Short Report

Geophysical Investigations on the Viking Period Platform Mound at Aska in Hagebyhöga Parish, Sweden

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ABSTRACT Aska hamlet in Hagebyhöga parish, Östergötland (Sweden), is famous among Viking scholars for a rich female burial under a low cairn that was excavated in 1920. The main visible archaeological feature of the site is an enormous barrow, but its contents have not been excavated. As the barrow is oval and has an extensive flat top, it has been hypothesized previously that rather than a grave superstructure, this might be an uncommonly large raised foundation for a long house. We occasionally see this type of feature at elite manorial sites from the period AD 400–1100. We have tested this idea at Aska with ground-penetrating radar, securing the clear and detailed floor plan of a post-supported hall building almost 50 m long. Its closest known architectural parallel, also sitting on a similar platform, has been excavated at Old Uppsala, the late first millennium AD political and ceremonial centre of the ancient Swedes. At Aska, it appears that we have found another such real-world correlate of the *Beowulf* poem's royal mead-hall Heorot, but in this case located in a smaller and less powerful polity. This all suggests a petty royal status for the owners of the Aska hall, who enjoyed connections with Scandinavia's top political elite. Copyright © 2014 John Wiley & Sons, Ltd.

Key words: Viking; long house; geophysics; GPR; ground-penetrating radar; Östergötland

Introduction

The Viking Period elite of Östergötland province in Sweden left a rich material record suggesting great wealth. An unprecedented centralization of power is visible in a great defensive dyke and an associated sea barrage, both major engineering projects dating most likely from the ninth century (Rundkvist, 2011, pp. 72–73). After a hiatus of almost two millennia, the period also saw a brief reappearance of major earthen barrows in the mortuary repertoire (Rundkvist, 2011, pp. 57–59). When Olof Eriksson was elected the first joint king of the Svear and the Götar in about AD 1000, Östergötland became one of the original provinces forming the Kingdom of Sweden (Gahrn, 1988).

Looking at the period's elite indicators in the archaeological record, the province's most dense and qualitatively most diverse cluster is in two adjoining parishes near the town of Vadstena at the western end of Östergötland's plains belt: Hagebyhöga and St Per/Vadstena (Table 1). The richest and most diverse site in this cluster is the hamlet of Aska in Hagebyhöga (Figure 1). It is mainly known to archaeologists for a rich tenth century burial with a silver female figurine (Arne, 1932), found under a modest superstructure a few hundred metres to the west of the hamlet. The most eye-catching feature of the site, however, is a great barrow at Aska's hilltop northern end, commanding the surrounding landscape. Radiocarbon analysis of a shin bone from an articulated horse leg, incorporated into the barrow when it was built, places its erection in the

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Table 1. Eighth to tenth century elite indicators in the parishes of St Per/Vadstena and Hagebyhöga.

Location	Feature	Date	Source
Aska in Hagebyhöga	Great platform barrow	Seventh to ninth century	Claréus and Fernholm, 1999
Aska in Hagebyhöga	1885 rich weapon grave	Ninth century	SHM 7679
Aska in Hagebyhöga	1920 rich jewellery grave	Tenth century	Arne, 1932; Malmer and Wiséhn, 1982, p. 24
Aska in Hagebyhöga	2006 ploughed-out rich jewellery graves	Tenth century	Rundkvist, 2011, pp. 91–93
St Per	Frankish gold dinar	AD 780/781	Malmer and Wiséhn, 1982, p. 142; Ilisch, 2004; Carlsson and Jonsson, 2012
Fridhem/Hagalund in St Per	Rich weapon graves	Ninth century	Lindqvist, 2000, p. 24
Huvudstad in St Per	Stray spearhead	Not known	SHM 17947
Kvarnbacken in St Per	Rich jewellery grave	Late ninth century	Karlsson, 2008

SHM: Swedish History Museum's inventory.

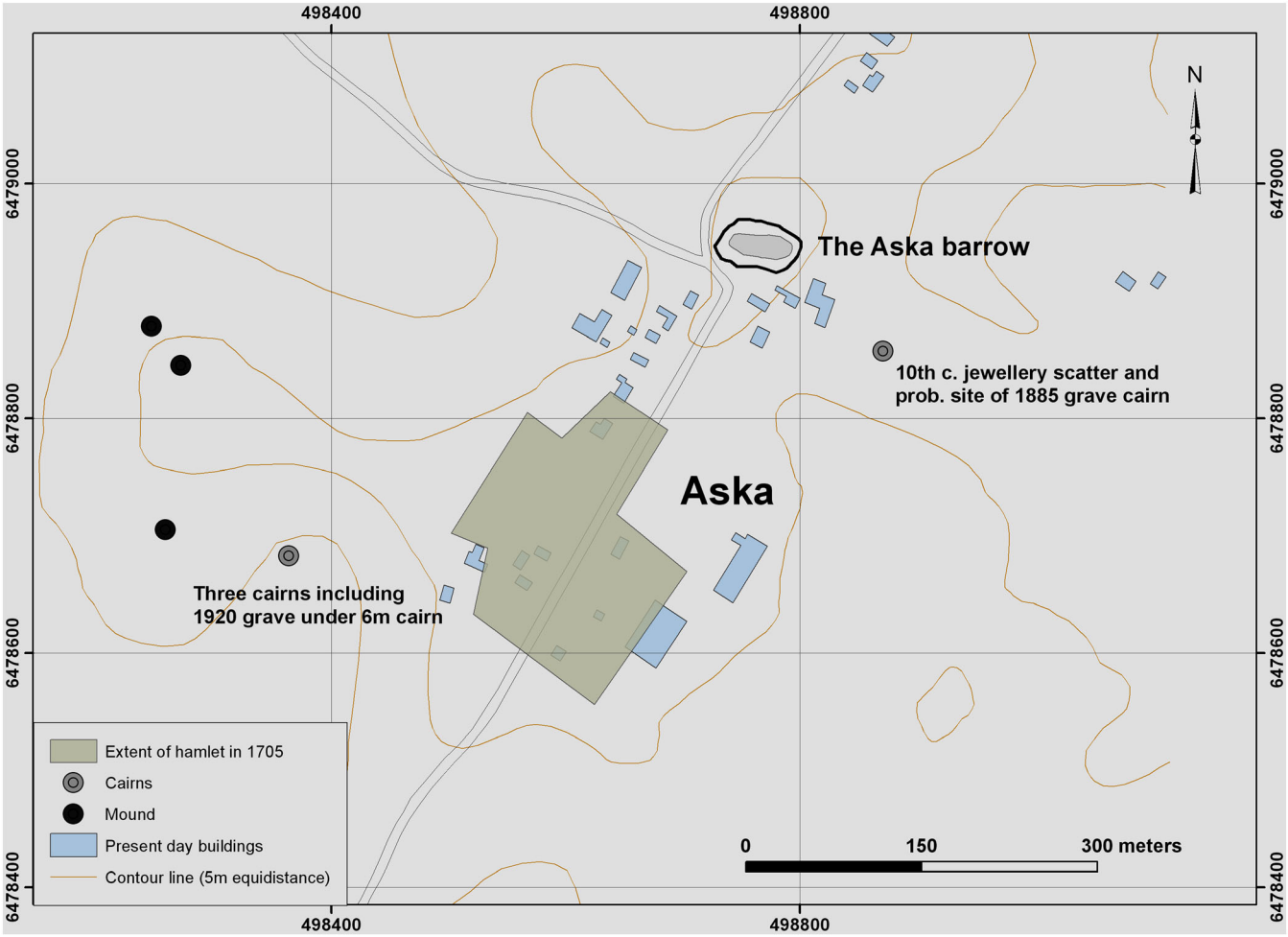

Figure 1. Aska hamlet in Hagebyhöga parish, Östergötland. Grid coordinates in Sweref99 TM. This figure is available in colour online at wileyonlinelibrary.com/journal/arp

interval 660–880 cal AD (St-11326, 1270 ± 100 years BP; Claréus and Fernholm, 1999). Finds in the fill and structural remains encountered beneath the mound suggest that it covers a cremation cemetery from about AD 1, with the mound reusing material from the older graves.

The Aska barrow is oddly shaped. The other two dated major Viking Period barrows in the province (at Ledberg church and Stora Tollstad in Sjögestad) are simply round and domed. Their Aska counterpart is oval and flat-topped, like a raised tennis court. The

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level top surface measures ca. 55 m by 18 m and is elevated 3 m above the surrounding ground. In 1985–1986, Carin Claréus and Ragnhild Fernholm (1999) determined through trial trenching that the barrow has a stone cairn at its core, like a normal burial mound. In this core cairn, under which they found no cremation layer in their small trenches, they found the aforementioned horse bones.

Is this really a burial mound? Or is it an unusually large platform for an ostentatious hall building, like for example those of Old Uppsala and Fornsigtuna (Allerstav *et al.*, 1991; Ljungkvist and Frölund, in press)? This was first suggested by Anders Carlsson at a research seminar in Stockholm, in September 2005. The idea entered the literature with a 2006 paper by Carlsson's student Anne D. Stenberg. One of the authors has noted the possibility (Rundkvist, 2011, pp. 64, 91), but has not previously committed himself to either interpretation. In 2012 Anders Carlsson himself went on record arguing in favour of the building platform interpretation (Carlsson and Jonsson, 2012). Indeed, nineteenth century local tradition had it that a monastery had once stood on the mound (although Carl Fredrik Nordenskjöld (1875, p. 87) suggested that this came out of a confusion of names between *Aska by*, 'Aska hamlet', and the well-known Medieval nunnery in Askeby parish).

Written sources, notably the *Beowulf* poem, describe the feasting hall as the nexus of the Scandinavian late Iron Age's political, religious and social life, and it has been routinely identified in the archaeology for decades (Herschend, 1993, 1998; Lönnroth, 1997; Söderberg, 2005). In 2012 Björn Hjulström and his team (2014) found Östergötland's first foundation of such an edifice at Ströja in Kvillinge parish. It was built in the fifth century AD on flat ground and was used at least up until the eighth century. We therefore decided to use non-destructive geophysics to investigate whether the Aska mound may have been built as a foundation for a later and even more ostentatious mead hall.

Methods

Geophysical methods were not used much in Swedish archaeology until the mid-2000s (Viberg, 2012). Now, however, ground-penetrating radar (GPR) has become increasingly popular. It was first used for archaeological purposes in Sweden in 1979, only a few years after its initial archaeological evaluation in the USA in 1974 (Vickers and Dolphin, 1975). Since then GPR has been used frequently in many parts of the world to investigate a wide range of archaeological remains (e.g. Goodman and Nishimura, 1993; Conyers and Connell, 2007; Trinks *et al.*, 2010; Damiata *et al.*, 2013), including successful surveys of Iron Age long houses in Scandinavia (e.g. Trinks *et al.*, 2007; Anderson Stamnes, 2010).

One of the primary benefits of GPR is its ability to provide information on depth to buried structures. Another benefit is its ability to produce high-resolution images. The instrument can collect dense data, often every third to fifth centimetre inline. Depending on how closely the radar transects are spaced, different resolution levels can be achieved. During previous research investigations a spacing of 0.5 m or less was preferred (Neubauer *et al.*, 2002, p. 155; Leckebusch, 2003, p. 216). When aiming for the detection of small archaeological features, such as postholes, this distance needs to be roughly as short as half the diameter of the expected feature in order to produce an interpretable picture of sufficient resolution (see discussion in Viberg *et al.*, 2011, p. 50; Viberg, 2012, p. 69ff). In order to produce true three-dimensional GPR results the distance between the transects must be even shorter (e.g. Grasmueck *et al.*, 2005; Novo *et al.*, 2010, 2012).

The roof-supporting postholes of the house type we were looking for are larger than 1 m in diameter and would thus probably be detected with a transect spacing of 0.5 m. However, as the postholes in the walls are commonly only 0.2–0.25 m in diameter, and in some cases even smaller, a transect spacing of 0.1 m or less would be appropriate in order to image these structures clearly. This sampling density can be compared with that of other geophysical methods, such as for example magnetometry and earth resistance with standard inline and crossline sampling spacings of 0.25–1 m (see e.g. table 1 in David *et al.*, 2008, p. 8). For more detailed discussions of GPR methodology see, for example, Daniels (2004), Conyers (2012, 2013) and Goodman and Piro (2013).

We surveyed the Aska mound's top surface with a ProEx system and a 500 MHz antenna from Malå Geoscience. Data were collected every 3 cm in transects separated by 10 cm within a 63.7 ns time window and a trace stacking factor of four. The size of the surveyed area was 45 × 13 m (Figures 2 and 3). Our fieldwork on the mound in April of 2013 took less than 1 day for two people. Viberg did the post-survey data processing with Reflex 2D/3D software. This included subtraction of DC-shift, first arrival alignment, background removal, bandpass filtering and gain. The data were subsequently migrated before generating depth slices for interpretation. The velocity of the radar wave was calculated at 0.09 m ns^{-1} by using hyperbola fitting (Conyers, 2013, pp. 125ff). Post-data-management

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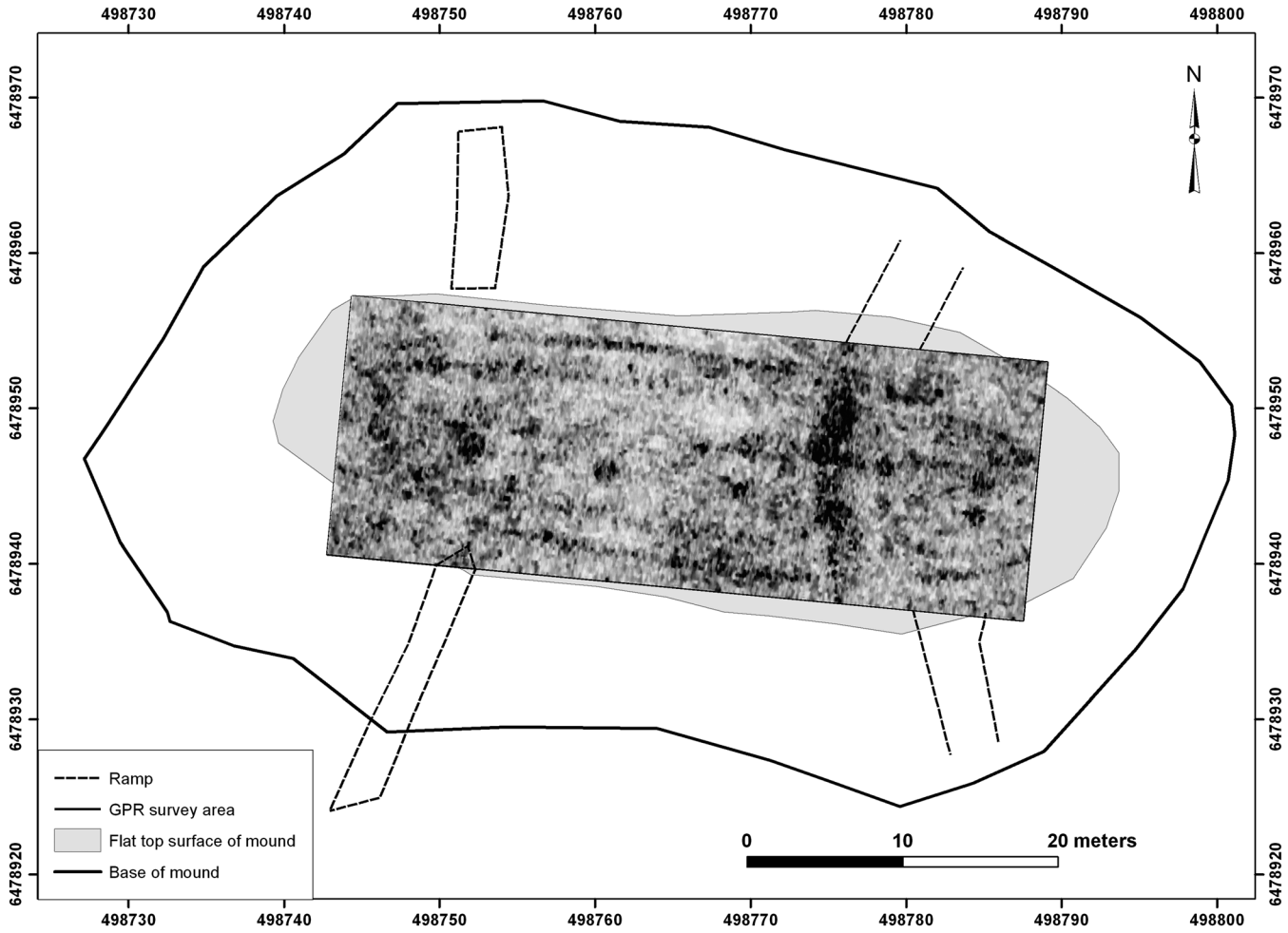

Figure 2. A GPR depth-slice of 2 ns thickness at a depth of 18 ns (ca. 0.8 m) below the surface. Depth estimations calculated with a radar velocity of 0.09 m ns^{-1}. Grid coordinates in Sweref99 TM.

interpretation was carried out by importing georeferenced depth-slices into ArcMap 10. Interpretation of the GPR data was carried out according to the work flow proposed by Poscetti (2013), and was strengthened by analysis of reflection profiles and a GPR animation file (see Neubauer *et al.* (2002) and supplementary GPR animation file A).

After surveying the mound's top surface, we spent some hours covering a small fallow field along the southern side of the mound's base with the GPR, dimensions 22 × 13 m, transect spacing 25 cm, but these lower-resolution data (supplementary GPR animation file B) did not reveal any building remains.

Geophysical results and interpretation

The GPR results show the layout of a post-borne three-aisled building measuring ca. 47.5 m in length (Figures 2 and 3 and supplementary GPR animation file A). As the gable ends are missing from the GPR data, this is an estimation based on the curvature of the wall lines. These lines consist of small, densely spaced postholes and are double. There is also a third line of more widely spaced postholes outside the walls on either side, which follow the curvature of the building. The distance between these postholes is fairly regular and ranges between 2.0 and 2.5 m. They may represent oblique wall-supporting buttress posts. Note that it is difficult to conclude whether the strong reflections in the GPR data, interpreted as postholes, are caused by a highly reflective soft posthole fill or by stones in the postholes and along the walls. Some of the larger roof-bearing posts are most likely stone-lined, which would increase their visibility in the GPR data.

The greatest width of the building is ca. 14 m and the greatest internal width between the wall lines is ca.

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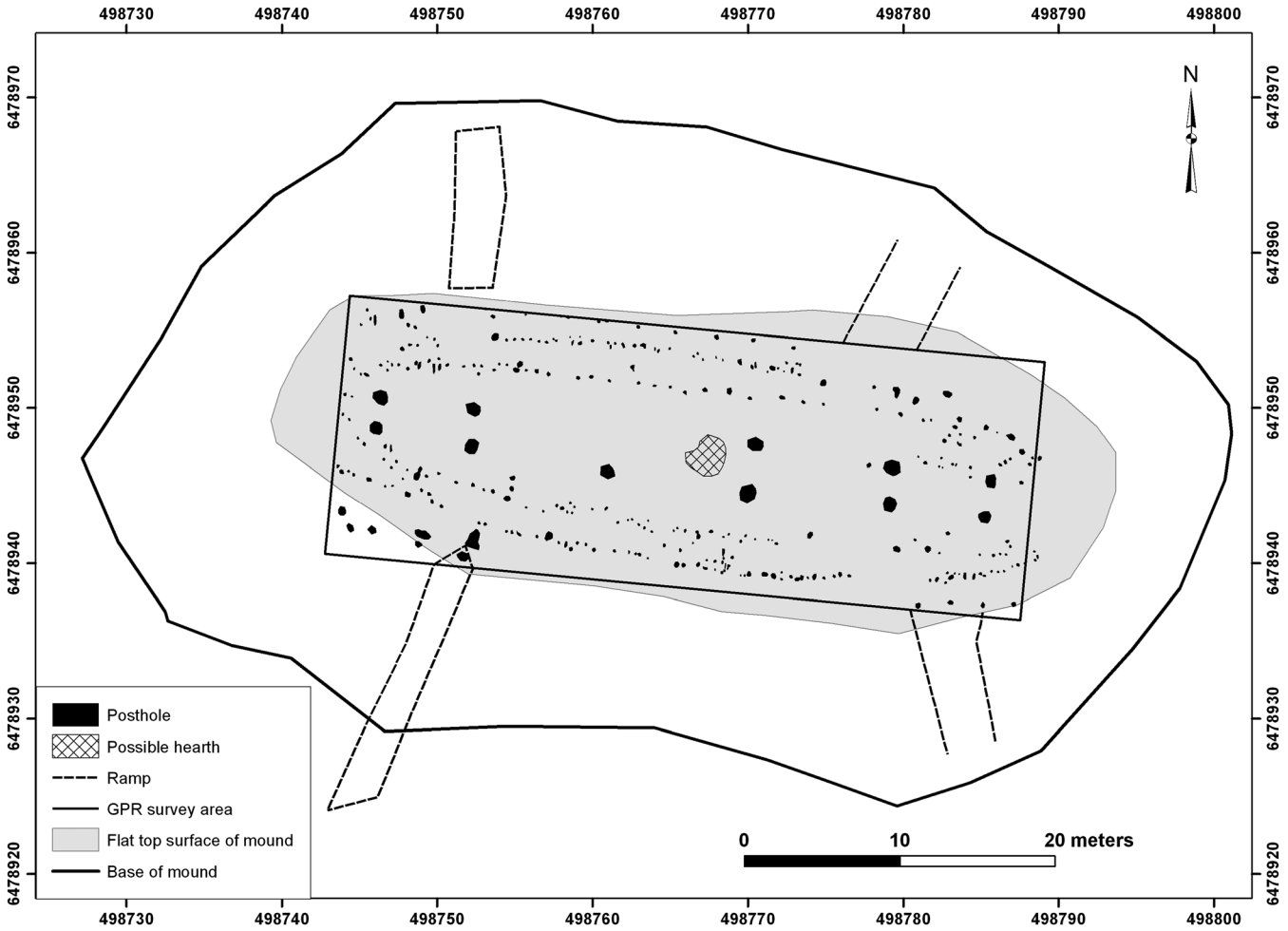

Figure 3. Interpretive plan of subsurface features on the platform mound as seen in GPR data. Grid coordinates in Sweref99 TM.

9 m. Six pairs of roof-bearing posts are visible in the data, dividing the building's interior into five bays, which we have numbered west to east. Each roof-bearing posthole measures roughly 1 m in diameter. The width between the posts in a pair ranges from 2 m at the gables to 3.5 m to either side of the middle bay (number 3). The distance between pairs of posts is 6 m in the end bays and 9 m in the three middle bays. There are also some weaker anomalies that may represent additional roof-bearing posts, but as these are uncertain we have omitted them from the interpretation. In the eastern half of the middle bay (number 3) is a high-reflecting anomaly, which, because of its location in the building, can be interpreted as a possible hearth with a diameter of ca. 2.5 m.

Four entrances are visible as interruptions in the otherwise continuous external wall line, aligned from either side on the second pair of roof posts counted from the gables. Ramps on the slopes of the platform (previously mentioned by a surveyor in 1760: Larsson, 1987, p. 25) led straight up to these entrances. Large postholes between the southwest entrance and the top of the ramp suggest a roofed porch. Similar porch postholes may await recognition outside the survey area in the northwest and southeast. Two distinctly larger postholes in the outer wall line at the northeast ramp suggest a small back door there, width ca. 1 m, where no sign of a porch is visible despite GPR coverage.

A line of strong radar reflections crosses the platform in bay 4 (Figure 2), suggesting a ditch or quarry associated with a modern earthen cellar dug into the northern slope of the platform there. Traces of this modern activity are also visible as a depression in the surface directly east of the line of anomalies. Part of this linear structure in the data may also be related to an inner wall dividing the building, and a few postholes may be hiding among the strong reflections, but as the disturbance from modern activities here is so severe this is mere speculation.

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Discussion

The Aska in Hagebyhöga hall building has no parallels in Östergötland. Its posthole layout, however, places it squarely in a category of late first millennium royal feasting halls known from sites including Lejre in Zealand and Old Uppsala and Fornsigtuna in Uppland (Allerstav *et al.*, 1991; Christensen, 1997; Ljungkvist and Frölund, in press). The large building platform finds its closest parallels to the north in the land of the Svear, but the strict symmetry of the posthole layout, the short gable bays, the widely and regularly spaced buttress postholes along the outsides and the roofed porch all point to the south, to the land of the Danes. Similar architecture has been abundantly documented in the Trelleborg-type tenth century ring forts built by the Jelling kings (Schmidt, 1994).

The closest parallel to the Aska hall known to us is a partly excavated and somewhat older royal hall at Old Uppsala (Figure 4; Ljungkvist and Frölund, in press). Even disregarding the large platforms common to both buildings, their posthole layouts are so similar that we must assume direct contact between the two royal families in question, possibly even an architect studying the Uppsala hall at the heart of Svealand and travelling on commission to Aska in central Götaland. The details of each building are summarised in Table 2. John Ljungkvist points out (e-mail 13 June 2013) that although the similarities are great, it should be noted that the space between the double walls is narrower in Old Uppsala.

Old Uppsala seems to have been Svealand's paramount political and religious centre from the later sixth through to the twelfth century (e.g. Sundquist *et al.*, 2013). Two of its great hall platforms are well preserved. The excavated hall there was built about AD 600, saw some remodelling in the eighth century and was apparently demolished in about AD 800 (Ljungkvist and Frölund, in press). This fits comfortably with the Aska hall's eighth or ninth century construction date, suggested by analysis of bone from the horse leg placed in the platform while it was being built. As the house foundation fits the shape and dimensions of the platform perfectly, it seems parsimonious to interpret the two as being devised and built together. This is not an ancient long barrow re-used after millennia for a purpose its builders had not envisioned. The extremely wealthy ninth and tenth century graves excavated at Aska suggest that the people buried in such state would have lived in a similarly grandiose building. Therefore, again, it appears parsimonious to envision the hall already standing on its platform during the lifetime of the man in the ninth century weapon grave (Table 1).

Claréus and Fernholm (1999, pp. 134–135) sunk seven narrow trenches into the mound, targeting the

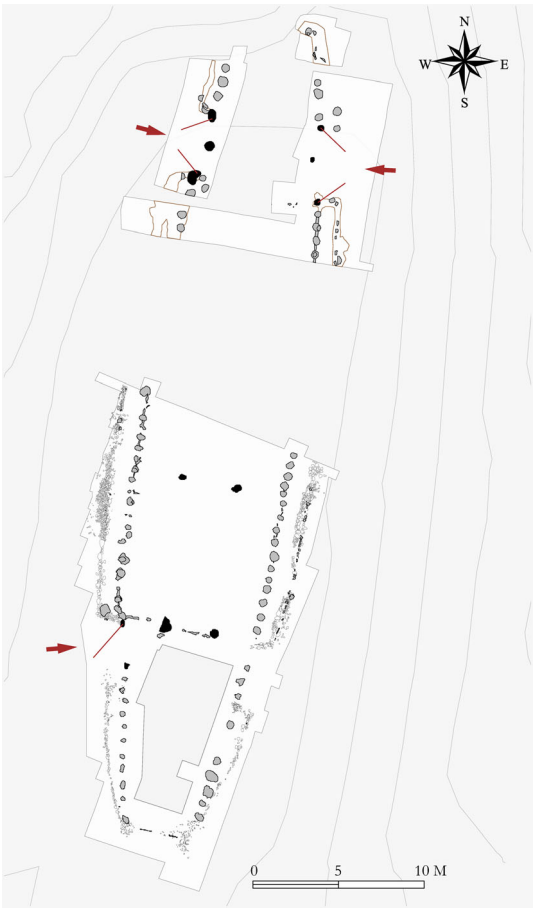

Figure 4. Old Uppsala. Foundation postholes of a hall building on a platform immediately north of the parish church. Plan by John Ljungqvist.

Table 2. Comparison of the long houses on platforms at Aska and Old Uppsala.

Feature	Aska	Old Uppsala
Length	ca. 47.5 m	50 m
Maximum width	14 m	12.5 m
Gable width	<4 m	4 m
L/W	ca. 0.29	0.26
Roof posts	6 pairs	4–6 pairs
Walls	Curved, double	Curved, double
Wall buttresses	Yes	Not determined
Entrances	4	4
Porch	Yes	Not determined
Platform maximum height	3.5 m on flat ground	>4 m on slope

southwest and northeast corners, the southeast ramp and 2 m^2 on the platform in the southern half of bay 4. Four of the trenches (numbers 4–7) were outside the GPR survey area, but the outlines of trenches 1–3 are faintly visible in the GPR data (see supplementary GPR animation file A). Trench 1 seems to have

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intersected both the inner and the outer wall line of the building in the southwest. Trench 3 intersected the inner wall in the eastern part of the platform. Both trenches were quite far from the unmistakable roof-bearing postholes. Trench 2 was unfortunately in the area heavily affected by modern activities, and the interpretation and comparison of excavation results and GPR data is, as a consequence, challenging there.

Conclusions

Geophysical investigation has confirmed the hypothesis of a long-house foundation on top of the Aska mound. The building was similar in plan to one of the royal halls at Old Uppsala, which stood on an even taller earthen platform. These observations reinforce Rundkvist's (2011, p. 78) interpretation that Aska in Hagebyhöga was a residence of the Viking Period petty kings of Östergötland, a faction or dynasty about which coeval written sources are silent. Nor do they say anything specific about the archaeologically attested class of feasting halls on earthen platforms, although the *Beowulf* poet does describe King Hrodgar's hall Heorot as a 'high house'.

The Viking Period of Sweden, unlike that of, for example, the Danelaw or Ireland, is just barely a proto-historical period. Östergötland is one of Sweden's best-documented provinces in the written sources, and even here they do not permit narrative history before the thirteenth century. Only the archaeological record can help to understand earlier developments. Postulating a petty royal dynasty that held sway over Östergötland and kept a palatial residence at Aska as early as the ninth century is, from a source-critical point of view, quite a daring contribution to the debate over Viking Period politics. Indirectly, we are identifying the famous jewellery burial excavated near Aska hamlet as that of a queen who stood in personal contact with the Swedish royalty of Old Uppsala and their Danish counterparts at Lejre.

As for geophysical surveys, they are an affordable, quick and non-destructive way to characterize underground building remains. In this case we already knew the age of the mound thanks to trial trenching and radiocarbon dating, but had we not, then we would nevertheless have been able to date and contextualize the Aska feasting hall by typological means, with reference to its partly excavated sibling at Old Uppsala – after only a few days' work. In addition our research shows the benefit of testing hypotheses of an historical nature with non-invasive methods as a way to go beyond just finding buried cultural materials to excavate (Conyers, 2010; Conyers and Leckebusch, 2010).

The power of this methodology is such that the important and difficult decision is no longer whether to do a survey, but *where* to do it. Aerial photography of cropmarks, parchmarks and driven snow is one way to form an idea, but the evidence from the Aska platform mound offers another avenue for future research: any raised earthworks with a flat and sufficiently large top surface is a potential building site, whether originally intended as such or not. With GPR, finding out if a building once stood on such a surface is no longer a major undertaking. The method offers a direct entry point into architectural typology (e.g. Göthberg, 2000), where prehistoric buildings can be dated and assigned a social context using dimensions and architectural design, without excavation – and in some cases these social indicators point straight at the top.

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